THE INTERNAL ANATOMY OF ICERYA PURCHASI.

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The external anatomy, habits and life history of *Icerya purchasi* are well known through the work of Riley, Comstock and others. The present paper contains notes on the internal anatomy of the female, certain details of which depart from any Coccid anatomy previously described.

This work was done in the Entomological Laboratory of Stanford University.

MOUTH PARTS.

(Plate XXVIII, Fig. 1.)

The essential features of the mouth parts of *Icerya purchasi* are the internal chitinous framework, pharynx, and labial cavity, the buccal setæ, and the external labium. The framework lies on the ventral body wall in a median line opposite the bases of the fore legs, only the posterior ventral side being exposed. The bases of the setæ and the pharynx are contained in the typical Coccid chitinized box-like structure, lying between two indefinitely five-sided areas. The lower plane, or area inferior, is considerably the larger. It is bounded on the front by the arcus formed by the fusion of the interior end of the costæ superiores and the costæ inferiores, and on the side by the right and left costæ inferiores, each of these, consisting of two parts, articulating with it. (Pl. XXVIII, fig. 1 b). The posterior end of each costa inferior joins with the corresponding part of each costa superior to form the clavus. (Pl. XXVIII, fig. 1 u).

On each side, joining the costæ as shown at the point b in fig. 1 of Plate XXVIII, and running ventrad toward the costæ superiores, is a chitinous piece, L, which branches just before reaching these costæ. One branch goes ventrad a short distance, lying free in the cavity; the other branch extends a little way caudad and serves as a support for the conical base of one of the setæ.

The upper plane, or area superior, is bounded on the front by the same fused arcus that bounds the lower area. On the sides it is bounded by the costæ superiores, each of which

consists of an anterior and posterior part, fused or articulated at the point o. A heavily chitinized plate, t, connects the entire lower halves of the costæ superiores.

The setæ consist of four very long, slender, solid rods, the bases of each being enlarged and forming an elongated cone, s, — s. Two of these cones lie on either side of the box, one pair being supported by branches from the piece l. The other pair of cones is supported by a heavily chitinized elongated structure, x, arising from the posterior surface (base) of the framework, and standing up within it, its anterior end being just above the point of articulation of the upper and lower halves of the costæ, and lying free within the cavity. Between the conical bases of the setæ and arising from the clavus is a short cone-shaped organ, lying just below the pharynx and œsophagus and possibly serving to protect them.

The four setæ come together at the clavus and are appressed to form a tube. This tube then passes backward into a long transparent pocket, the labial cavity, c. This pouch lies in the body cavity next to the ventral body wall, running back to the fourth segment. The tube extends the entire length of the labial cavity and forms a loop, returning to the point of entrance and passing out of the body through the labium.

The labium, z, is an external organ and does not have much movement except a slight backward and forward motion. It is a heavily chitinized, more or less heart-shaped structure, the lateral halves of which, originally separate, have been fused together. The setæ pass through the center and upper part of the labium and pass out of the lower or apical end. The labium is heavily musculated, and at its external opening a cross section shows a ridged or serrated structure.

ALIMENTARY CANAL.

(Plate XXVIII, Figs. 3 and 4.)

The œsophagus is long and slender, widening out as it approaches the proventriculus. It is strongly musculated with circular muscles, the inner wall consisting of a layer of small single-nucleated cells. Passing upward and backward it goes through the œsophageal commissures and enlarges into the proventriculus. Back of the proventriculus is the ventriculus proper.

The parent digestive cells of the ventriculus contain as many as five nuclei each, and there can be seen free cells in the ventriculus which have been given off from the attached parent cells. These free cells possibly assist in digesting the food.

The ventriculus runs back a short distance farther to about the junction of the sixth and seventh segments, and then turns abruptly and runs forward well past the junction of the œsophagus and the proventriculus. Here it makes a couple of turns, going backward and then forward to its junction with the ileum, at which point it widens out for a short distance.

The ileum is very short and is small in diameter. The colon is largest at its anterior end and then, growing smaller, runs backward and finally merges into the rectum. The rectum is in the seventh abdominal segment, and the anal opening is on the dorsal surface of this segment.

Salivary Glands. (Plate XXVIII, fig. 2).

The salivary glands are located on each side of the chitinized box of the mouthparts. There is one gland on each side, made up of three spherical cells, heavily nucleated. A duct, carrying the secretion, leads from each gland to the mouth.

Malpighian Tubules. (Plate XXVIII, fig. 3).

The malpighian tubules are three in number, convuluted and considerably longer than the intestine from its point of junction with the œsophagus to its most posterior point. The tubules are very dense, with heavily nucleated cells, and besides being convuluted, are curved to a certain extent at their posterior ends, and seem to be fastened to the ventriculus by a few very fine muscular fibres.

RESPIRATORY SYSTEM.

(Plate XXVIII, Fig. 7.)

There are two pairs of spiracles, the first pair being located on the ventral side of the prothorax, posterior to the anterior pair of legs, and the second pair between the meso- and metathorax on the ventral side posterior to the middle pair of legs. A groove extends from each spiracle to the margin.

Each spiracle has a somewhat kidney-shaped funnel-like opening, very strongly chitinized. A large trachea extends in from each spiracle on either side; this soon divides into three main tracheæ in the anterior system and four in the posterior

system. The anterior system of tracheæ soon re-divides many times. One of the secondary divisions forms, with the similar division of the opposite trachea, a transverse trunk just behind the chitinized box supporting the mouthparts. The other branches go to the antennæ and to the fore and mid legs and anterior part of the body.

From each spiracle of the posterior system four branches are given off, two very large, one smaller and one very small. These subdivide many times but, as far as could be determined, there is no connecting trunk between the two posterior tracheal systems. These posterior systems supply the hind legs, alimentary canal, reproductive system and all of the posterior portion of the body.

CIRCULATORY SYSTEM.

No definite dorsal vessel was found. The blood probably simply circulates through the open body cavity.

NERVOUS SYSTEM.

The nervous system consists of two large fused ganglia, lying ventrally in a median position and several nerves connected with these ganglia. The cephalic ganglion lies above and largely in front of the framework of the mouthparts. Its anterior and principal portion is large and triangular in shape and is distinctly bilaterally depressed into two large lobes. The posterior portion of the ganglion greatly diminishes in size and divides into two commissures, passing around the œsophagus.

From the under part of the central and most anterior portion of each lobe in the anterior part of the cephalic ganglion a small nerve runs to the antenna and from the anterior angles of each lobe and laterad of each antennal nerve the optic nerves proceed to the eyes.

The œsophageal commissures continue backward, passing above the fused arcus and gradually re-uniting and enlarging into the thoracic or infra-œsophageal ganglion. The thoracic ganglion is slightly depressed above the mid-dorsal and mid-ventral line. There are four very obvious transverse divisions, making in all four double-lobed parts or divisions of the thoracic ganglion. The posterior division is somewhat narrower and possibly more plainly divided than are the three

preceding ganglia. These "lines of division" are really, probably, lines of fusion of pairs of ventral ganglia distinct in embryonic life.

No nerves were found issuing from the first ganglion. From the second and third thoracic ganglia, rather large and prominent nerves proceed at nearly right angles. From the posterior division, two long, slender nerves extend back into the sixth or seventh abdominal segment, dividing along their course into three or four smaller nerves which run backward parallel to these posterior divisions.

REPRODUCTIVE ORGANS.

(Plate XXVIII, Fig. 5.)

The reproductive organs of the female consist of the ovaries, oviduct, vagina, spermatheca and vulva. The ovaries are very curiously developed in this insect. Instead of the customary pair of separate ones, lying one on either side of the alimentary canal and running caudad to unite in a common duct, ending in the vagina, the two ovaries are found united. No anterior division can be found and the whole forms a loop united by a continuous membrane. The posterior ends unite, forming the vagina, and run ventrad to the external opening. This oviduct widens and narrows with no apparent regularity. The ovarioles are fastened to the oviduct throughout its anterior half. They are not found on the posterior ends of the loop, but the point where they stop is not clearly defined. In some specimens it is much nearer the vagina than in others. The ovarioles are given off from the oviduct either as single expansions connected by a long, slender tube, or in bunches or groups of from two to eight or ten. Usually the connecting tube is longer where there is but a single ovariole than where there are several. The larger ovarioles are all given off singly, while the clusters occur as a number of much smaller ovarioles. Each ovariole, no matter what its size may be, is more or less oval in shape, and at its distal end there is always a constriction and a head, fitting the larger part of the ovariole like a circular cap.

The spermatheca is a transparent pouch given off midway of the vagina. The vulva is a strongly musculated, oval, external orifice.

WAX GLANDS.

(Plate XXVIII, Fig. 6.)

The wax glands are scattered pretty well over the body, especially on the dorsal aspect of the thorax and on the dorsal and lateral aspect of the last three segments of the abdomen.

There are two kinds of glands, the most numerous consisting of a single more or less balloon-shaped or oval cell with an external chitinized pore. This cell contains several nuclei and very faint longitudinal divisions, each division containing one of these nuclei. The external pore is very heavily chitinized, and is more or less horse-shoe-shaped with semi-circular chitinized structures lying on each side of the horse shoe.

The second kind of wax glands has the chitinized pore or tubercle prolonged into a long, stout spine at the base of which is a cup-shaped secretory gland.

EXPLANATION OF PLATE XXVIII.

Anatomy of **Icerya purchasi.**

Fig. 1: Mouthparts.
Fig. 2. Salivary glands.
Fig. 3. Alimentary canal and malpighian tubules.
Fig. 4. Cross section of ventriculus.
Fig. 5. Reproductive system.
Fig. 6. Wax gland.
Fig. 7. Respiratory system; a, anterior aspircle and trachæa; b, posterior spiracle and trachæa.